

V. *Life-history of three species of Western Pacific Rhopalocera.* By GERVASE F. MATHEW, R.N., F.L.S., &c.

[Read February 4th, 1885.]

PLATE X.

Papilio Schmeltzi, Herr.-Schäff.

This fine butterfly, which I believe is the largest* species inhabiting the Fijian Islands, was not uncommon at Suva and Levuka in May, June, and August, 1882-3-4, and I also met with it at Mango and Vanua Balavu, and it probably occurs upon all the other islands of the group.

From notes I have been able to make of its habits I am inclined to believe that there is a succession of broods throughout the year, although they are doubtless more plentiful during certain months. They are difficult to obtain in perfect condition, for they frequent thick forest undergrowth, where they soon lose their tails and get their wings torn. They fly in an irregular jerky manner, and, when frightened, go off at a rapid pace.

On June 6th, 1884, while collecting in the forest near Suva, I saw a female fluttering about a small shrub in a shady spot beneath some thick-foliaged trees. I had long hunted in vain for the larva among a variety of what I had imagined were likely food-plants, and now at last the secret was about to be disclosed. Keeping perfectly still, I watched, as the butterfly flitted from twig to twig, and presently saw her alight upon a leaf, and, with vibrating wings, thrust her abdomen beneath

* I have a large female *Ornithoptera* (I believe an undescribed species) which was given to me by a friend, who assured me that he had received it from Fiji; but I have spoken to many people at Suva and Levuka, and they are all confident that they have never seen or heard of such a large butterfly, nor do the natives know of it. However, it is not impossible that such a species may exist in the less explored portions of the islands, particularly in Vanua Levu, the large northern island.

it, and in a moment the egg was deposited! She then flew up and wheeled several times round the bush, but, as she showed no disposition to lay another egg, I netted her, as she was a remarkably fine and perfect specimen. Upon examining the shrub I found the egg fixed to the under side of the leaf, not far from the tip, and, after thus discovering the food-plant, I had not much difficulty in finding a supply of ova, larvæ, and a few pupæ.

The shrub upon which the larvæ feed is a species of *Aralia* (probably a small variety of *Aralia ritiensis* of A. Gray), and at a little distance reminds one of our English spindle-tree. It grows to a height of from eight to ten feet, bears broadly lanceolate dark glossy green leaves, and clusters of small white sweetly-smelling flowers, with a perfume something like that of privet. Its berries are at first green, but turn to bright scarlet when ripe. They germinate freely, but do not seem to grow quickly, for the ground in the neighbourhood of an old bush is often thickly covered with little plants about a foot high, with a single stem nearly as thick as one's little finger. It was upon these small plants, growing in shady places, that the larvæ, &c., were chiefly to be found. Sometimes as many as three or four ova were to be seen upon a single leaf, but they were probably deposited by different females, as they were generally of different age. As a rule the same female only lays one egg upon the same leaf, though she may deposit several upon the same plant. These ova were terribly subject to the attacks of a minute hymenopterous parasite. Only about one in a dozen produced a larva, the remainder giving birth to three or four ichneumons, so small that they were barely visible to the naked eye.

The egg is perfectly globular above and flattened at the base. When newly laid it is of a pale straw-yellow, but changes to orange in about twenty-four hours, and a couple of days before the larva emerges to a mottled grey, the black head of the young caterpillar showing plainly through the upper part of the shell.

The egg laid on morning of June 6th hatched on the afternoon of June 11th. After resting for a little while the young larva turned round and carefully devoured the empty shell. It was then a quaint-looking little creature; its head black and shining; 2nd segment surmounted by a pair of white-branched spines, seated upon ear-like

protuberances pointing forward over the head on each side, and forming a kind of hood; dorsal surface greyish white, with a black bar across the 4th and 5th segments; subspiracular and ventral region black, subdorsal white; branched spines upon each segment, those on the anal segment being the longest, and pointing backwards.

After the first moult the markings of the larvæ remain much the same, but the ear-like protuberances are not so conspicuous, and assume a spiny appearance, and the white spines have become reduced to small, fleshy, wart-like tubercles of a reddish-brown colour upon all the segments but the 6th, 7th, 12th, and 13th, where they are white.

After the second moult there is a marked difference in the appearance of the larva; its whole surface is of a glistening reddish-brown colour, and the 3rd, 4th, and 5th segments have become much thickened; the spines upon the 2nd segment, projecting over the head, are of a creamy white, and a nuchal Y-shaped tentacle is emitted between them when the larva is irritated; there is an oblique whitish stripe on 8th and 9th segments, and an irregular whitish subdorsal spot on the 11th and 12th segments, and a narrow shining white subspiracular line. At this stage of its existence the larva has a peculiar slimy appearance, its skin looking as if it was too tight for it.

After the third moult the larva somewhat loses this shining peculiarity, and more nearly approaches its final dress, the reddish brown giving way to mottled greens, greenish yellows, browns, and reds.

The full-grown larva is from 50 mm. to 55 mm. long, rather stout and plump in proportion to its length, and with the 3rd, 4th, and 5th segments considerably thickened; there are two small pointed tubercles upon the crown of the 2nd segment, just behind the head, and from between these, when the larva is annoyed, it protrudes its peculiar Y-shaped nuchal tentacle, which is of a bright carmine colour; there are also three or four small blunt tubercles on each side of the dorsal line on the 3rd, 4th, and 5th segments, and faint indications of tubercles on each side of the dorsal line on the remaining segments, those on the anal segment being conspicuous and pointing backwards. The whole colour of the upper surface, as far as the spiracular stripe, a beautiful apple-green, mottled and marbled

with oblique and transverse markings of darker, paler, and golden green; upon the 3rd, 4th, and 5th segments the golden green predominates, and towards the spiracular stripe, upon the 3rd segment, there is a blotch of greenish blue; a broad glistening white stripe, very narrowly bordered by black above, above the spiracles, and extending from anterior of 5th segment and terminating in anal flap just above the claspers; a triangular brownish-red patch running from mouth obliquely upwards to dorsal line, and having its base on posterior of 5th segment; a broad oblique stripe on 8th segment springs from the spiracular stripe, and runs backwards a little into the 9th segment nearly to dorsal line, blackish red above and mottled with white and grey below, its lower part forming a triangular blotch; a similar but smaller stripe on 10th segment; head and legs reddish brown; ventral and anal claspers pale slate-colour; under surface whitish, mottled with grey; spines golden green.

The above is a description of what appears to be the typical larva, but they vary a good deal, some having scarcely any oblique or transverse markings, while others are beautifully marbled with madder-brown or golden olive.

When full-fed the larva remains in one position for about twenty-four hours, during which period it voids the contents of its intestinal canal. It then proceeds to spin the usual pad of silk for the insertion of the anal hooks of the chrysalis, and, having completed this and its silken girdle, it remains quiescent for another twenty-four hours, or generally less, and then changes to a chrysalis.

None of the larvæ I reared showed any disposition to wander when they were full-grown, but attached themselves to the twig where they last fed, and took no pains whatever to conceal themselves; and those I found at large were equally exposed.

Neither the larvæ nor chrysalids, as far as I could see, appear to be subject to the attacks of ichneumons, for all those I found produced butterflies, and the numerous empty chrysalids I saw showed no signs of having given birth to anything else than their lawful occupants. But once I happened to come across a chrysalis which had only just turned, and while it was in a soft and helpless state was being attacked by a number of very small red

ants, who had managed to bore their way into it, and its violent writhing attracted my attention. When I passed that way again a few hours after there was nothing left but a little piece of shell attached to the anal hooks. If this chrysalis had had time to harden I do not believe the ants could have harmed it.

The chrysalis is from 30 mm. to 35 mm. long, angulated; head strongly bifid; back considerably humped; sheath of haustellum prominent; body much pinched in at centre, where the suspending silken girdle supports it; ridged subdorsally, and with two small tubercles each side of lower part of abdomen; all the upper parts of a beautiful deep bluish green; costal portion of wing-sheath streaked with silvery white; a spiracular silvery white abdominal streak; a short ventral silvery stripe near the anal point; central portion of the abdomen bright golden green, forming a conspicuous triangular mark; sheath of haustellum and other parts slightly tinged with golden green. Shortly before the butterfly emerges the chrysalis changes to a deep leaden green colour, and then to black, and the butterflies generally appeared between seven and eight in the morning.

Papilio Godeffroyi, Semp.

This is, I believe, the only species of *Papilio* (and the largest butterfly) occurring in the Samoan islands. It was common near Apia, on the island of Opolu, and at Pango-Pango, on the island of Tutuila, in June, 1884, and is probably to be found upon all the islands of the group. I was fortunate enough to take it in all its stages. Its habits are almost similar to those of *Papilio Schmeltzi*. The perfect insect flies rapidly among the forest trees, and often ascends to a considerable height, being attracted by the flowers on the topmost branches. I only succeeded in capturing one, although I had several other chances. They fly in a wild irregular manner, and are difficult to net. The larvæ were not uncommon, and I took them of all sizes. They fed perfectly exposed upon young stunted plants of *Aralia* growing in shady and sheltered places. This *Aralia* differed slightly from the Fijian, the leaves being larger and the shrub altogether more robust; but it was evidently merely a climatic variety.

The ova were attached to the under sides of the leaves

in the same manner as those of *Papilio Schmeltzi*, and were similar in every particular. They were also terribly attacked by the same kind of parasite. Here, however, the similarity ceases, for the larvæ, chrysalids, and perfect insects are quite different.

The young larva is black, with a white V-shaped mark on the back, running through the 5th and 6th segments. Spines black, those upon the anterior segments being the longest, and curved backwards at their tips; head black and shining.

After the first moult there is very little change, the white V-shaped mark is slightly larger, and the general colour smoky black.

At the third stage the head is black and shining; general colour dusky black; a greyish-white oblique stripe runs up from spiracular line from 5th segment to apex of 6th segment, and joins over the back, and appears, when the larva is viewed from above, like a broad V-shaped mark; a shining white line just above each of the ventral claspers; subdorsal conspicuous, curved pointed spines upon 2nd to 13th segments, those on the 2nd segment the longest, and pointing outwards, and slightly curved backwards at the tip, and with an additional small spine at their base; and there is also an additional spine upon the 3rd and 4th segments, between the subdorsal row and spiracles; the spines on 6th to 8th segments are very small; ventral and anal claspers slaty gray.

The fourth stage is similar to the third stage, with the following exceptions: the whole larva has become very shining, and looks as if its skin was too tight for it; the V-shaped mark is much smaller; the spines are smaller, and of a golden-brown colour, tipped with black; the spines on 6th to 8th segments have disappeared; the white stripe above the ventral claspers to anal segment is much broader; the ventral claspers shining whitish grey.

The full-grown larva is from 50 mm. to 55 mm. long, rather plump, tapering slightly towards the anal extremity, and with the 4th, 5th, and 6th segments considerably thickened; whole colour a beautiful golden green; oblique darker green stripes pointing backwards; a darker narrow dorsal line widening out to a diamond-shaped longitudinal spot at the segmental divisions; a double stripe between this and the oblique stripes; from

the 2nd segment, in a line with the mouth, a somewhat triangular blotch of a deep velvety madder-brown runs obliquely upwards through 3rd and 4th to base of 5th segment, and connects over the back with a similar marking on the other side; this stripe is continued through the 6th segment, where it meets the broad shining white stripe, which runs above claspers to vent; the triangular blotch is bordered above by a pale golden-green line; on 8th and 10th segments a somewhat triangular madder-purple blotch, bordered above by a narrow white stripe; head shining brownish green, with a narrow white line down centre of face, and a V-shaped mark over mouth; legs pale reddish brown; ventral and anal claspers smoky black; two bluntish orange-coloured spines upon the 2nd segment, just behind the head, and at the base of each of these a minute orange tubercle, between which, and a little to the rear of the spines, is the nuchal valve, through which, when the larva is irritated, the usual tentacles are emitted: the tentacles are of a deep carmine, and give off the accustomed pungent odour; on 3rd and 4th segments a pair of subdorsal blunt spines; on 5th, and from 9th to 13th segments, a single subdorsal spine on each side; all the spines orange, faintly tipped with black.

These larvæ varied a good deal; in some the oblique stripes and triangular blotches were entirely absent, the whole surface, above the white spiracular stripe, being of a beautiful green, more or less marbled or streaked with darker and golden greens; while one or two larvæ I took had the markings upon one side only! a circumstance I do not remember to have met with before.

The chrysalis is from 30 mm. to 35 mm. long, angulated; head very strongly bifid, the extreme points tipped with black; back gradually arched; sheath of haustellum prominent; costal edge of wing-case ridged; body pinched in at centre; whole surface a beautiful golden apple-green; spiracles well marked, darker; segmental divisions clearly defined, pale yellowish brown.

The chrysalis is invariably attached to the midrib of a leaf, while those of *Papilio Schmeltzi* are just as invariably attached to a stem.

There was a peculiarity about these larvæ which I have not seen mentioned as having been noticed in the larvæ of any other species of *Papilio*. On the crown of the 2nd segment, just behind the head, there is a horny

plate, with a transverse slit or valve in it, through which the nuchal tentacle is emitted; and when this tentacle is thrust out to its fullest extent the larvæ have the additional power of shooting out a fine, colourless, thread-like filament from the tip of each branch of the tentacle, the larva tossing its head backwards, or moving it rapidly from side to side all the time. As soon as the cause of irritation is over these little filaments are first withdrawn before the tentacle itself disappears through the valve-like aperture. All the time the tentacle is exposed an unpleasant pungent odour, as of rotten oranges, is distinctly perceptible; but this is, I believe, common to most larvæ of the *Papilionidæ*. In confinement I noticed that the larvæ fed only by day, remaining perfectly quiescent during the night; and the larvæ of *P. Schmeltzi* have the same habits.

Rearing larvæ on board ship is, of course, attended with much difficulty, as it is nearly impossible to obtain a constant supply of fresh food for them. However, in the case of the larvæ just described I found it easy to dig up small plants—about a foot high—of *Aralia* (taking care to see that there was as much earth as possible attached to the roots). These I placed in empty biscuit-tins, with more earth, and kept well watered, and found that they remained fresh for weeks. Indeed, as I write this (August 21st), the plants are still alive, and throwing out a new crop of leaves. Another thing in my favour was that during the two months the larvæ were feeding we were cruising among the Fijian, Samoan, and Tonga Islands, where plenty of the food could be got, and, as we were seldom at sea for more than a few days at a time, I was able to gather fresh food pretty frequently, and only allowed the larvæ to eat the growing plants when we were actually at sea and their other food had shrivelled.

The tins were secured upon a table in my cabin, and on the wall behind these were some pictures framed in maroon-coloured velvet. One morning I noticed that a larva of *Papilio Godeffroyi* had attached itself to a leaf which was almost touching one of these frames, and when I looked at it the next morning I was surprised to see that it had changed to a chrysalis of a beautiful deep rose-colour. After this I thought I would try some experiments, so I pinned some twigs, to which were attached larvæ that were on the point of changing, to

pieces of cork, to which I had gummed scarlet, blue, black, yellow, and white papers. Those placed on scarlet and white changed to rosy-pink chrysalids, those on blue and yellow to green, and those on black to very dark green. The chrysalids of *Papilio Godeffroyi* have a thinner shell, and are more delicate than those of *Papilio Schmeltzi*, and in consequence they were probably more susceptible to rays of light, for the former were more influenced by the colour of the background than the latter. The newly-changed chrysalids of both species were pale green, and it was not until several hours had elapsed that they assumed the colour of their surroundings. They are also very soft, and are covered with a thin coating of some viscid substance, which may have the power of absorbing refracted rays of colour-light as they dry and harden.

The *Aralia* grew more abundantly upon the Tongan islands than at Samoa or Fiji, but I saw no signs whatever of either of these butterflies at Tongatabu, Vavua, or Lefuka (the three islands of the group which we visited), at which I was rather surprised, for these groups are not very far apart.

Xois Sesara, Hew.

This beautiful little butterfly, which appears to be confined entirely to the Fijian Islands, is usually to be seen by the sides of paths in the bush, or in moderately open spots in the forest where the ground is overgrown with a thin carpeting of a species of couch-grass, upon which its larvæ feed. It flies in a weak uncertain manner, and frequently alights upon a blade of grass or upon a flower. I watched the females time after time in the hope of seeing them deposit their eggs, but never detected them doing so; so I came to the conclusion that they are dropped as the butterflies fly over the grass. Of course I was very anxious to find the larvæ, and had many a long and unavailing hunt for them; and it was not until the afternoon of August 2nd, 1884, that my labours were crowned with success. In a certain pathway through the bush, near Suva, there was a small open spot where the grass grew in patches, and here *X. Sesara* were flying in considerably numbers, and many of them looked as if they were dropping their eggs; so, thinking this was a likely place, I went down on my hands and knees and tore the grass up by the roots, and

shook it over a clear piece of ground, which I had previously prepared for the purpose, as I thought it very possible that the larvæ might be night-feeders, concealing themselves among the roots during the day. At the very first shake, to my infinite delight, out dropped an unmistakable Satyrid larva, which, of course, could be no other than that of *X. Sesara*, for the only other Satyrid occurring near Suva is the ubiquitous *Melanitis Leda*, whose larva I was very well acquainted with. This larva appeared to be about full-grown, and, having found it so easily, I thought there would not be much difficulty in getting a plentiful supply of them; but a couple of hours' hard work under a broiling sun only produced two more of them, one the same size as the first, and the other about half-grown. A few days after I found three more small larvæ near the same place. One or two pieces of the food-plant dug up by the roots, with earth attached, and placed in a small wide-mouthed bottle, kept alive and fresh and continued to throw up young shoots in my cabin for several weeks; and upon these the half-dozen larvæ were successfully reared, and produced butterflies at Sydney during September.

The larvæ in confinement were rather sluggish in their habits, and when not feeding rested upon a dead or withered blade of grass, well down towards the roots, and their colour so harmonised with the dried stems that they were difficult to see. When annoyed they generally curled themselves into a ring and fell to the ground, though sometimes they remained on the blade of grass and raised their anterior segments *Sphinx*-like.

The full-grown larva is from 18 mm. to 20 mm. long, cylindrical, tapering towards each extremity, and with the anal segment produced into two points; head smooth, subcordate, slightly porrected, and manifestly larger than the 2nd segment; whole colour a light pinkish brown, or pinkish putty-colour; dorsal stripe darker and bordered on each side by a line of a still deeper shade; subdorsal line darker than the general ground colour, and bordered below by another line of a paler hue, and below this there are several longitudinal lines; just above the spiracles there is a pale waved line, and below them a conspicuous pale stripe; spiracles very small and black; ventral surface slightly darker than the upper; head same colour as the body, with a

small V-shaped mark above the mouth, a line down the centre, and three waved lines on each side of face; ocelli deep brown. The whole larva is covered with very minute raised dots, which give it rather a roughened appearance, and there are also a few fine hairs, which, however, are scarcely visible to the naked eye; segmental divisions clearly defined.

One of the small larvæ, when I first took it, was pale green, with pinkish dorsal and lateral lines, but became drab or putty-colour when it was about half-grown.

When ready to pupate the larva attaches itself by its anal hooks to a pad of silk spun on the under side of a grass-stem, and generally well down towards the roots of the plant.

The chrysalis is 9 mm. long, short and stumpy, with the margins of the wing-sheaths strongly ridged; a ridge across the back from just beyond the anal angle of wing-sheath, and two conspicuous curved ridges on back of abdomen, and one smaller one; several small dorsal tubercles. Whole surface a warm putty-colour, reticulated and dotted with reddish brown; keel of ridges rather darker. One chrysalis out of six was of a beautiful pale golden green, with the margins of the wing-sheaths pink, and a few scattered pink dots and lines.

This butterfly was very abundant near Suva, on the island of Viti Levu, and at Levuka on Ovalau; but I did not meet with it at Mago or Vanua Balavu, two other islands of the Fijian group. It occurs throughout the year.

EXPLANATION OF PLATE X.

- FIG. 1. Larva of *Papilio Schmeltzi*.
2. Pupa of " "
3. Larva of *P. Godeffroyi*.
4. Pupa of "
5, 6. Larva of *Xoïs Sesara*.
7. Pupa of " "
8. " " " (green var).
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9. *Triscolia patricialis*, Burm.
10. *Scolionima insignis*, Butl.
11. *Mygymia aviculus*, Sauss.
12. *Coloborhombus fasciutipennis*, C. O. Waterh.